

**CLAIMS:**

What is claimed is:

1. A method for forming a thermoelement for a thermoelectric cooler, the method comprising:
  - 5 forming a first substrate having a plurality of pointed tips covered by a metallic layer, portions of the metallic layer being covered by an insulating material, and other portions of the metallic layer being exposed;
  - 10 covering portions of the metallic layer that are exposed with a thermoelectric material overcoat; and
  - 15 fusing a second substrate of thermoelectric material to the thermoelectric material overcoat.
2. The method as recited in claim 1, wherein forming a substrate having a plurality of pointed tips comprises:
  - 15 forming a substrate having a plurality of pointed tips separated by valleys;
  - 20 coating the substrate with a layer of metal;
  - 25 coating the layer of metal with a layer of insulating material;
  - 30 filling the valleys with a sacrificial material; and
  - 35 removing sacrificial and insulating material to expose the plurality of tips.
3. The method as recited in claim 1, wherein fusing the second substrate of thermoelectric material to the pointed tips comprises melting the thermoelectric material overcoat.

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4. The method as recited in claim 3, wherein the thermoelectric material overcoat is melted by heating the first substrate.

5. The method as recited in claim 4, wherein the first substrate is heated to approximately 550 degrees Celsius.

6. The method as recited in claim 3, wherein the thermoelectric material overcoat is melted by passing a current through the tips in order to induce Joule heating of the thermoelectric material overcoat.

10 7. A system for forming a thermoelement for a thermoelectric cooler, the system comprising:

means for forming a first substrate having a plurality of pointed tips covered by a metallic layer, portions of the metallic layer being covered by an insulating material, and other portions of the metallic layer being exposed;

means for covering portions of the metallic layer that are exposed with a thermoelectric material overcoat; and

20 means for fusing a second substrate of thermoelectric material to the thermoelectric material overcoat.

8. The system as recited in claim 7, wherein forming a substrate having a plurality of pointed tips separated by valleys comprises:

means for forming a substrate having a plurality of pointed tips separated by valleys;

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means for coating the substrate with a layer of metal;

means for coating the layer of metal with a layer of insulating material;

5 means for filling the valleys with a sacrificial material; and

means for removing sacrificial and insulating material to expose the plurality of tips.

9. The system as recited in claim 7, wherein fusing the  
10 second substrate of thermoelectric material to the pointed tips comprises melting the thermoelectric material overcoat.

10. The system as recited in claim 9, wherein the thermoelectric material overcoat is melted by heating the  
15 first substrate.

11. The system as recited in claim 10, wherein the first substrate is heated to approximately 550 degrees Celsius.

12. The system as recited in claim 9, wherein the thermoelectric material overcoat is melted by passing a  
20 current through the tips in order to induce Joule heating of the thermoelectric material overcoat.

13. A method for forming a thermoelement for use in a thermoelectric cooler, the method comprising:

25 forming a first substrate having a plurality of pointed tips covered with a thermoelectric overcoat;

fusing a second substrate of thermoelectric material to the pointed tips of the first substrate.

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14. The method as recited in claim 13, wherein fusing the second substrate comprises:

mechanically aligning the second substrate to the pointed tips; and

5 melting the thermoelectric overcoat.

15. The method as recited in claim 14, wherein the thermoelectric overcoat is melted by heating the first substrate.

16. The method as recited in claim 15, wherein the first substrate is heated to approximately 550 degrees Celsius.

17. The method as recited in claim 14, wherein the thermoelectric overcoat is melted by passing a electric current through the pointed tips to induce Joule heating of the thermoelectric overcoat.

15 18. A thermoelectric cooler, comprising:

a first substrate having a plurality of pointed tips, the apexes of the tips having a selectively deposited overcoat thermoelectric material;

20 a second substrate of planar thermoelectric material; and

fused connections between the overcoat thermoelectric material and the planar thermoelectric material.

19. The thermoelectric cooler as recited in claim 18, 25 wherein the planar thermoelectric material comprises a super lattice material.

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